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In This Issue

ON OUR COVER—Success of a Boeing B-52 in breaking 11 speed and distance records is pictured by artist Alden Metcalf, who shows the giant plane streaking toward a landing in Spain. Charles Tibbetts of National Aeronautics Association was official observer.

PHOTO CREDITS—Royal Swedish Navy (3, 4, 5); Paul Wagner (8, 9); Gyrodine Company (10); Byron Wingett (11, 14); Vern Manion (11); Jack Barkus (12, 13); James Lewis (12); and Kenneth Gretemann (12).

THE BOEING COMPANY
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THE BRIEFING

Precisely at midnight, January 10, Maj. Clyde P. Evely advanced the throttles and his B-52H missile bomber thundered into the sky from Kadena Air Base on Okinawa. Quickly sighting Tokyo, the Stratofort sped eastward at more than 660 mph.

At such speeds, the day is shortened by one-half. During the ensuing 22 hours Major Evely and his crew flew through two periods of darkness and two of daylight before completing their mission. It was January 11, 1:52 in the afternoon at Madrid, Spain, when they flashed over the city at 50,000 feet.

As the airplane eased onto the runway at Madrid's Torrejon Air Base its sparkling appearance brought exclamations of admiration from the waiting throng of American and Spanish military and government officials and members of the international press.

With 11 distance or speed records established, Distinguished Flying Crosses and other awards awaited the crew.

Speaking to newsmen after the flight, Aircraft Commander Evely in a manner characteristic of the men of SAC, somewhat depreciated the achievement, emphasizing that any combat-ready crew with any B-52H at his home base with the 15th Air Force's 4136th Strategic Wing at Minot, North Dakota, could have successfully flown the same mission.

In addition to the 39-year-old aircraft commander, whose home is Petersburg, Virginia, the crew included Capt. Edward McLaughlin, Greenwood, Ark., electronics warfare officer; Master Sgt. Richard Posten, Rainell, W. Va., gunner; Capt. Henry Sienkiewicz, Dornsife, Pa., co-pilot; Maj. Dwight Baker, Dayton, Ind., radar-navigator; Maj. Robert Carson, Flint, Mich., alternate aircraft commander; Maj. Edmund Bible, Coshocton, Ohio, navigator, and 1st Lt. William Telford, Brooklyn, N. Y., alternate navigator.

The mission was conducted to learn, "Exactly how far can the B-52H fly without refueling, and how fast?"

The answers were: 12,519 miles in 21 hours, 52 minutes, at an average of 575 mph with plenty of reserve fuel at the end of the flight.

SAC's commander-in-chief, Gen. Thomas S. Power, had this to say, ". . . That the more than 12,000-mile flight was completed non-stop and without refueling clearly demonstrates the intercontinental capabilities of the B-52 bomber. The flight proved that SAC aircraft have the capability of reaching target destinations in any area of the globe."

Boeing Vertol helicopters help defend Sweden

ACROSS LAND AND SEA

By JERRY L. ETTER

IN THE COLD WAR, Sweden follows a foreign policy of non-alignment, siding with neither East nor West. Yet, peaceful as its intentions are, it must support a strong defense establishment to protect itself, to ensure that it will not be aligned against its will because of its strategic importance.

Geographically Sweden is a northern continuation of the boundary between East and West, lying on the free side of the Iron Curtain. It nudges the Arctic Circle with one end while the other extends well into the temperate zone. Its coastline is wrinkled, with islands nearby, and much of the country is made up of forests and mountains.

Sea communications, important in the days of the Vikings, are as important to the nation's life today as ever before, for to survive Sweden must be able to transport the products of its forests, mines and industries and trade them for other necessities of modern civilized life.

Sweden's front line of defense is the Baltic Sea, the North Sea and the borders of Norway and Finland. To cover the 3,000-mile front, its armed forces must be equipped with weapons and transport capable of operating in temperatures varying from comfortable to extremely cold. A number of Vertol 44 helicopters have been engaged in this work since 1958.

New equipment recently ordered by Sweden to aid in its defense are special versions of the advanced Boeing Vertol 107 twin-turbine transport helicopter. Two have been

Boeing Vertol HKP-4 helicopters being built for Sweden are special versions of the 107 model.

ordered by the Royal Swedish Navy and four by the Air Force. All are designated HKP-4s. It is indicative of the 107's versatility that they will serve as units of a defense weapon system and also as angels of mercy.

In the Royal Swedish Navy the helicopters will serve in submarine hunter-killer teams.

Today's Royal Swedish Navy, a far cry from the Tenth Century Viking fleets, is not a marauding force. Like all of Sweden's armed forces, it is a guard, dedicated to thwarting any attack on Sweden's independence. The prime task of the Navy is to prevent an aggressor nation from using the sea as a means of transporting troops and supplies against Sweden and to ensure the safety of the country's vital maritime communications.

Should an attack ever be launched against the Swedish coast, the Navy would be the first line of defense at sea-level.

The Royal Swedish Navy planners believe that today, with the availability of atomic and thermonuclear bombs, it is inadvisable to concentrate a force in a small number of heavy units. Operational areas in which the Swedish Fleet would be called upon to fight are basically unsuitable to large units.

Yet ships in the fleet must be sufficiently seaworthy to operate in all weather. It follows that the helicopters that work with the fleet must also be able to operate under the same conditions.

The Swedish Fleet of today is described as a "balanced light fleet." Fast ships up to destroyer size predominate, plus two modern cruisers. Motor torpedo boats, large and small, are included and submarines and mine-laying and mine-sweeping vessels have essential places.

An important part of the Royal Swedish Navy's job in wartime would be to defend against submarines and clear the waters of mines. Latest addition to the Navy, the helicopter service is equipped to help in the work. Its principal task is antisubmarine activity. Crews of the Vertol 44s now in service are trained to search out undersea craft and pinpoint their positions so that surface vessels can come in for the kill. Helicopters also are valuable for towing mine-sweeping gear and carrying commando troops.

Another contribution the Vertol 44s have made is the training and experience they have given the helicopter crews who will man the more effective 107s when they enter service. Already skilled in the use of modern helicopters in modern naval tactics, these men will be prepared to get the best out of the all-weather, twin-turbine 107s.

According to the Navy, its choice of the 107s is explained by "their great stability at hovering and towing, their good qualities for instrument flight and the liberty in distribution of the load." The safety of having two engines also influenced the selection.

In all weather, day or night, the Navy helicopters will be able to make the transition automatically from forward flight to hovering and to hover at a certain altitude once the transition has been made, while sonar equipment with which the crew "listens" for submarines is dunked in the sea.

The Navy helicopters will be equipped with retractable hooks for towing and minesweeping missions.

On the sea and along the coast the Royal Swedish Navy stands guard. In the air, only ten minutes from Russia at jet speeds, the Swedish Air Force defends the peace that Sweden has enjoyed since 1814.

Stated mission of the Swedish Air Force is to prevent an enemy from gaining air supremacy above Swedish territory and to cooperate with land and sea forces. While the Royal Swedish Navy traces its history back to the 16th Century, the Swedish Air Force is no late-comer in terms of aviation's history. Just four years after the first flight of the Wright Brothers, an air force was formed in Sweden with a small number of aircraft divided between

Vertol 44 helicopters have been serving the Royal Swedish Navy since 1958.

the Army and the Navy. It became an independent service in 1926.

Today the Swedish Air Force is made up of nine day-fighter wings, two all-weather fighter wings, four attack wings, five reconnaissance squadrons, one air-base corps and one search-and-rescue unit. These are formed into four groups. The air rescue unit, to which three of the Boeing Vertol 107s will be assigned, is called the Flygraddningsgruppen.

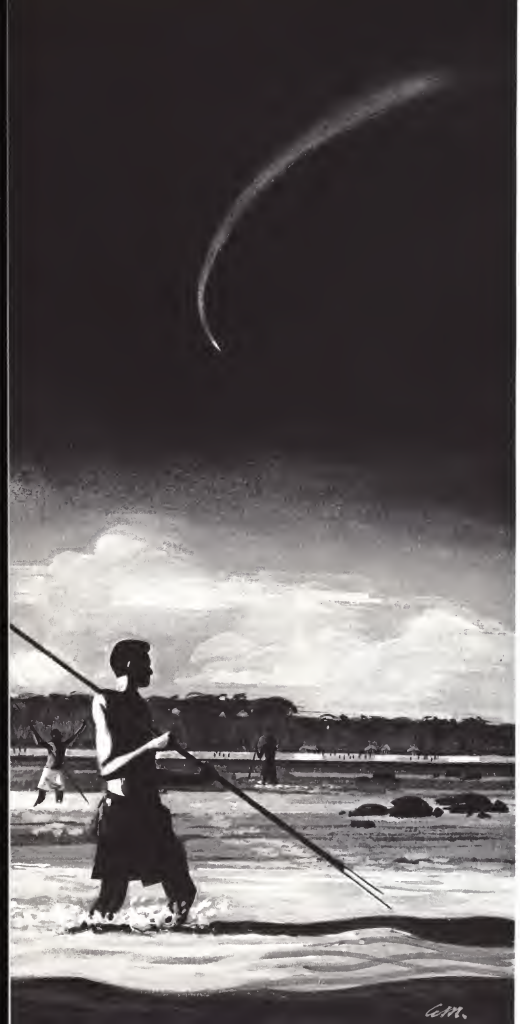
These groups must all be prepared to operate in winter over frigid northern Sweden and the ice-bound Baltic Sea. Special winter survival training is mandatory for air crews in addition to standard emergency and ditching drills and compass and map practice.

Where the temperature can hover far below the zero point and day can be a few hours of twilight, downed air crews must know how to keep themselves alive. The speed with which they can be rescued under such conditions is vital, and speed is one of the things the 107s will provide. The all-weather capability and long range of the 107 are equally important.

Each Air Force 107 will be equipped with an integrated loading system and a 600-pound-capacity cargo and personnel hoist which can lower a cable and rescue harness through a rescue hatch in the floor at mid-cabin. The hoist also will be capable of personnel rescue through the forward cabin door by use of a quickly detachable rescue boom. One of the helicopters will be assigned to the job of providing transport to radar and radio stations.

The helicopters for Sweden will be the first 107s to have deHavilland Gnome engines, produced under license from General Electric. The aircraft will be capable of carrying external loads up to 10,000 pounds with an external cargo hook. With two 500-gallon tanks, each helicopter will have a range of 700 miles carrying a 2,000-pound payload.

Like all other 107s, the Swedish aircraft will be able to cruise at 155 miles an hour. These aircraft can land on and take off from earth, snow or water. Temperatures as low as 65 degrees F. below zero will not stop them.



New booster

ALL

By WILLIAM JURY

SHOWING a football quarterback's disdain for the short pass, the Air Force has elected to go all the way in one play with its Dyna-Soar space glider.

Plans to use modified Titan II ballistic missiles to boost manned Dyna-Soar gliders on short suborbital flights have been abandoned. The Air Force, instead, has ordered the development of a more powerful booster, one capable of hurling a Dyna-Soar glider into full orbit.

Few details have been released concerning the new booster. One approach to the design, the Air Force has disclosed, would be based on Titan II technology and would incorporate large solid-propellant rocket motors as the first stage.

The new booster will be assembled by the Martin-Marietta Corp., builder of the Titan I and Titan II. Within industry, the booster already has been tagged the "Titan III."

Boeing, system contractor for the Dyna-Soar program, is adapting the glider design to meet new booster requirements.

This is not the first time that Dyna-Soar planners have been kept hopping by technology's rapid pace. In January, 1961, the Air Force took a second look at the Titan I (which it had selected to boost Dyna-Soar) and decided to use the then-new Titan II instead.

Even the Titan II, however, was incapable of rocketing the Dyna-Soar glider and its pilot to orbital

will send Dyna-Soar

THE WAY IN ONE PLAY

velocities. Designed as an intercontinental ballistic missile, the booster stood 102 feet high, its girth was more than 30 feet, and it could hurl a hydrogen warhead more than 6,000 miles. But it didn't have the muscle to put the airplane-like Dyna-Soar into orbit.

Consequently, the ground-launch program was to begin with Titan II-boosted suborbital flights over the Atlantic Missile Range in the manner of the early Project Mercury shots. When more powerful boosters became available, orbital flights from Cape Canaveral, Florida, to the dry lake bed at Edwards Air Force Base, California, were to follow.

With a more powerful booster in sight, the Air Force now can drop its plans for suborbital flights and move from the air-drops directly to the around-the-world shot.

Here is the sequence of flight tests now planned for the Air Force space glider program:

Air-drops of unpowered gliders from a B-52 mother ship at Edwards AFB to check the craft's stability and control at slow speeds, and to give pilots opportunities to perfect landing techniques. Later, gliders equipped with rocket engines will be flown faster than sound to see how they handle in the supersonic regime.

At the conclusion of the Edwards tests, unmanned and manned flights around the world will be launched from Cape Canaveral. These tests will check every phase of Dyna-Soar's operation, including stability and control, performance, and the effects of aerodynamic heating on the craft during re-entry.

Is the Air Force taking a terrible risk by eliminating the suborbital shots from the flight test program? On the contrary, the orbital flight probably will pose fewer problems for the pilot than the short one.

Boeing engineers believe the extra hour involved in an around-the-world flight will give the pilot time to adjust to his chores in space, set up his re-entry conditions, and make the necessary preparations before beginning his descent through the atmosphere. The landing, too, will be made at a familiar site—the dry lake bed at Edwards—with the aid of ground-based facilities used in the air-drop sequences.

Contrast this with a suborbital shot to a down-range island in the Atlantic. Immediately after boost, the pilot would have to prepare for re-entry. The up-and-down flight would make the task of landing at a tiny island base comparable to steering a runaway hay wagon down a mountain road.

The suborbital series never has held much appeal for people who have spent years with the program and are eager to demonstrate Dyna-Soar's tremendous potential.

"It's like giving the bunt sign to Roger Maris," one engineer observed.

The Air Force did not say how much time might be saved in Dyna-Soar's development by the decision to give it an orbital booster. The initial announcement only said that the new booster will assure "early attainment" of manned orbital flight. It did not disclose when the first flight would take place. No official schedule for Dyna-Soar development ever has been announced.

Main purpose of the suborbital flights was to gain data on hypersonic flight, a regime never before sampled by manned winged vehicles. This is the speed range beyond Mach 6. The new program will explore this area and accomplish orbital flight as well.

Some of the world's outstanding scientists and engineers have worked on the Dyna-Soar concept for nearly three decades—first as an extension of the skip-glide idea proposed by the Austrian physicist Dr. Eugen Saenger, and later as the single-pass re-entry glider now being developed.

It is ironic, therefore, that the first human to witness the fiery return of a Dyna-Soar glider to the atmosphere quite likely will be an aborigine of some small Pacific island. For when the Dyna-Soar pilot brings his craft back from space, he probably will begin his re-entry somewhere over Oceania.

The native very likely will blame the phenomenon on witchcraft or fermented coconut juice. A more proper and tumultuous welcome will have to wait until the pilot and his delta-winged craft cross the California coast—about 45 minutes later as the Dyna-Soar flies.


PAN AM
N760PA
PAN AMERIC

The first 707-320B is named

EVENING STAR

By ROBERT NEPRUD

A JET AIRLINER capable of whisking 133 passengers and their baggage plus 10,000 pounds of cargo the 5,400 miles from Honolulu to New York in a single, giant leap—that's the new Boeing 707-320B Intercontinental.

The first of these big, ocean-vaulting jets, powered by four Pratt & Whitney JT3D-3 turbofan engines packing 18,000 pounds of thrust apiece, was photographed for this page early in January on the Transport Division's pre-flight line at Renton, Washington.

Since then the plane, named the Evening Star, has made its maiden flight and commenced Boeing and Federal Aviation Agency type-certification tests—a chore which it will share with two sister ships. Delivery of a fully-certified 707-320B will be late this spring.

Pan American, Trans World Airlines, Lufthansa German Airlines and Air France will add 707-320Bs to their fleets.

Thanks to its more powerful and economical turbofan engines, coupled with a new, high-lift wing and other aerodynamic improvements, the B Intercontinental will be capable of flying a distance 20 per cent greater than a straight-jet Intercontinental with the same payload.

New leading- and trailing-edge wing flaps, already flight-tested on the 707 prototype airplane, have been incorporated in the 707-320B. Low-drag wing tips and other wing and fuselage changes also contribute to improved performance.

The 707-320B has double thrust reversers which act on both the forward (or fan) airstream and on the exhaust, providing a more effective reverse thrust for shorter landing roll. Thanks to these high-lift, short-roll improvements, runway length requirements have been reduced substantially.

Navy's new helicopter will be sub killer.

DASH IS DEADLY

By ALLEN HOBBS

THE U. S. NAVY'S newest anti-submarine weapon is a drone coaxial-rotor helicopter powered by a Boeing T50 gas turbine engine.

Developed by Gyrodyne Company of America, the helicopter is the principal unit of the Navy's Dash (drone anti-submarine helicopter) weapons system.

The turbine helicopter made its first flight in April 1961 at Gyrodyne's Long Island headquarters. On initial flights a test pilot manually controlled the helicopter; unmanned test flights are now under way.

One of the latest advances in the nation's anti-submarine potential, Dash is designed to operate by remote control from a destroyer. The highly maneuverable drone will carry sub-killing homing torpedoes.

A typical mission will involve the detection of a submarine by the destroyer's sonar gear, guidance of the drone helicopter to the area of the submarine where the drone will hover until instructed to drop its weapons, and then fly back to the parent ship for rearming.

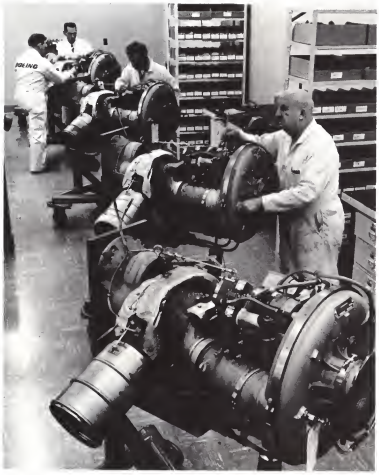
Modern destroyer sonar gear, which can pick up a submarine many miles away and deep below the surface, together with the drone helicopter, will extend a destroyer's attack capabilities and enable the destroyer to strike with homing torpedoes long before the submarine expects hostile action.

Newly built destroyers and destroyers being modernized under the Navy's Fleet Rehabilitation and Modernization program will be equipped with Dash. A landing area and heated hangar is located immediately aft of each destroyer's after smoke stack.

The T50-BO-4 helicopter engine powering this new weapon was developed and put into production through Navy encouragement and a combination of Navy and Boeing funds. Boeing is the only U. S. manufacturer with production contracts for a helicopter turbine of less than 600 shaft horsepower.

The T50 is a two-shaft turbine similar to the familiar Boeing 502 powerplants. The first model of the Boeing turbine was put into production ten years ago and since that time has evolved into a series of advanced high-performance production engines.

The T50 is the first gas turbine in the 200 to 350 horsepower class to receive an approved 150-hour qualification rating which clears the way for installation of this powerplant in a production helicopter. The Boeing engine passed this tough and important qualification test on its first try with no deteri-



T50 engines for Dash are manufactured in Seattle.

A T50 engine is readied for green run in test cell.

oration in performance at the end of the test.

Henry C. Hill, chief project engineer for the T50 program, commented that the successful completion of the unusually clean 150-hour test on the first attempt was due to the long development and service background of the basic engine design.

The drone helicopter engine, however, includes features such as turbine wheels and other engine hot parts utilizing higher-strength, higher-temperature-resistant alloys; a newly designed output section which allows the engine to be cantilevered from the helicopter transmission; an integral oil cooler, and an output-section governor system of special design.

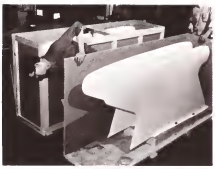
Robert M. Titus, Boeing program manager of military engines, points out "the close working relationship between the Navy, Gyrodyne and ourselves has enabled us to put into production rapidly new engine design concepts such as integral oil cooling and cantilever mounting which add importantly to Dash operation."

The use of an integral air-eductor oil cooling system on the T50 replaces the complexity and power loss of a mechanically driven fan and external oil plumbing and cooler.

A specially designed output-section governor system simplifies control procedures by providing constant helicopter rotor speed independent of helicopter power demands. The engine and helicopter also have been mated to permit removal or installation of the engine in 20 minutes.

Single-stage components and hydro-dynamic or slipper-thrust bearings, a hallmark of Boeing engines, make possible an ease of maintenance with this type of engine that is unequalled in the small-turbine powerplant field. These features enable Boeing commercial turbines to use a 1,000-hour overhaul rating.

The vibration-free flow of power from the T50 free-turbine engine will eliminate piston power pulses to the critical helicopter transmission and should materially help the Dash weapons system develop a comparable reliability record.



Air bases are supplied by unusual B-52 parts store.

WEAPONS SYSTEM SERVICE STATION

By DARRELL BARTEE

A NEW, automated art has been developed in the Boeing B-52 Stratofortress spare parts supply operation at Wichita.

The spares section has 85,260 items of supply on active lists for the B-52, and currently is supplying ordered items to 10 Air Materiel Areas and 40 air bases. From Wichita's service-minded part supply center more than 200 Stratofort parts are shipped or monitored every day via truck, rail and air.

To perform the complete service on an on-time basis, the spares specialists have devised a series of advanced techniques.

For example, two electronic computers, a 7080 and a 1401, now swiftly and accurately process spares data formerly handled by lesser machines, or by hand. In the warehouses where spares are boxed and shipped, the area is laced with new conveyor devices and automatic packaging equipment. New packing materials and methods are tested and adopted as fast as they come along.

The spares-supply job is complicated by the sophistication of today's weapon system. Parts configurations change as bomber models are improved and missiles are added. Lead time is always critical on new Strategic Air Command requirements. Fast and knowledgeable recommendations must be made to the Air Force, for future spares needs.

Provision must be made for high-priority orders. Government procurement policy must be followed to the letter, in competitive bidding, inventory control, economy measures and reports. Spares carrying a "HiValu" designation (those in higher cost categories) require spe-

Electronic data, engineering research, new packaging and shipping methods are part of an advanced spares program for B-52 Stratoforts.

cial attention to keep the Air Force inventory down. High quality must be maintained for all spares, including those furnished through Boeing by 3,970 suppliers who have subcontracts in 43 states.

Concentrated at Wichita is the most complete collection of engineering data on the bomber weapon systems to be found under one roof. The company uses this unique mass of information as the touchstone of its product-support techniques.

Airplane spare parts range from small bolts, washers and screws, to such items as leading edges, landing-gear doors, rudders and wing tips. Some are items subject to wear. Others are subject to accident or damage by weather. And still others, such as gaskets and bushings, are needed in overhaul and repair. Included are quick-engine-change kits.

Wichita spares engineers establish initial support requirements and review each follow-on order to make sure the part will fit the airplane configuration concerned and that it is the latest design for maximum durability and efficiency. This requires a system of all-out configuration surveillance to enable spares personnel to pinpoint changes made in systems, assemblies and kits.

The plant uses the most advanced methods of fabrication. Extensive use of tape-controlled machine tools provides extra speed and economy.

In the electronic processing (EDP) of spares data, the two big computers handle an enormous volume of detail in split-second style. Once the original data are fed into EDP, the information is carried automatically from one program to another.

The 7080 computer can race through the whole series of 85,260 items and produce a part number-Federal stock number cross reference in less than 40 minutes.

Illustrated parts manuals provided by Boeing are an important source of information for SAC. There are more than 15,000 pages on the B-52, and all data are integrated with the EDP system. Manuals are kept up to date at the rate of about 1,570 revised pages per month.

Expediters with special training and long experience speed high-priority orders. In one recent month there were more than 1,500 of these hurry-up orders.

The new supply techniques at Wichita are aided by the fact that key personnel in the section have an average of 12.9 years of experience. They know exactly how to do the job—how to get the right parts in the right amounts to the right place at the right time.

Spacecraft materials yield secrets when

TESTED BY SEARCHLIGHT

By DONALD BRANNON

A PAIR of used searchlights and a bit of ingenuity have been parlayed into one of the nation's fastest facilities for determining heat-loss characteristics of space-age materials. This knowledge is essential to accurate prediction of temperatures which will be generated in missiles or spacecraft reentering the atmosphere.

The rate at which a hot material throws off heat energy as its temperature rises is controlled by its radiating efficiency, called its emissivity. This characteristic is the key to material temperatures during reentry.

These temperatures largely determine the structural configuration, insulation and types of systems built into missiles and spacecraft. Boeing thus has a vital interest in learning the emissivity characteristics of new materials.

A material's emissivity is determined by inherent characteristics, surface roughness and sometimes color. Because emissivity rates for each material vary at different temperatures, many tests must be made for each of the numerous materials being studied.

This volume of testing demands a facility capable of delivering fast results. Boeing's searchlight method fills this need, testing specimens at the rate of about 50 every three days. Other methods considered are far slower.

The Boeing facility is located in

Searchlights use these 10,000-watt lamps to provide fast heat for testing space-age materials.

Specimen at focal point turns white hot.

a small laboratory at Seattle. Two 36-inch searchlights borrowed from the Navy face each other, their brilliantly polished mirrors about 8 feet apart. A fat, 12-inch-diameter bulb stands in one searchlight. The other searchlight contains a water-cooled fixture which holds a domino-sized test specimen.

Two inches from the specimen is one end of a four-foot tube. It leads to an adjacent optical pyrometer, an instrument which measures material temperatures by color intensity.

An engineer fastens a test specimen in the fixture, steps back and snaps three switches. The 10,000-watt bulb comes alive with searing intensity. An electrical buzz mingles with the hiss of cooling exhaust fans in the searchlights. Beside the lights an automatic data recording device fingers a line of ink across a scroll of moving paper.

In the first searchlight, temperature in the bulb quickly soars to 5,500 degrees F, bouncing heat off the mirror through regulating louvers to the second searchlight. There another mirror gathers the heat and focuses it on a one-square-inch spot on the test specimen. The odor of superheated metal drifts through the laboratory as the specimen glows white and rapidly heats to nearly 3,000 degrees.

Close by, the engineer squints through the pyrometer, makes an adjustment and notes it on the data sheet. The recorder grinds out the specimen's emissivity secrets.

Boeing materials and processes people report excellent results with the searchlight method. Sample data have checked accurately with those obtained by different methods of testing.

Among the many materials being tested are coated refractory alloys, molybdenum, columbium, tantalum, tungsten and ceramics.

RCAF ON TARGET

THE FIRST Canadian Bomarc missile fired scored a bull's eye. Streaking over the Gulf of Mexico on the U. S. Air Force Eglin test range, the missile intercepted a QB-47 target drone at an altitude of more than 40,000 feet, approximately 350 nautical miles from the launch shelter.

The firing was a recent high point for Royal Canadian Air Force missilemen of the 446th Squadron of North Bay, Ontario, who were receiving training at Eglin.

The North Bay base is scheduled to become operational this year. Construction is progressing on another Canadian Bomarc base at La Macaza, Quebec.

An operational Bomarc base is manned by personnel who never press a trigger or direct an attack. Their job is to keep their missiles in ready-to-go condition. Their skills are in maintenance of electronics, ramjet and rocket engines, air munitions and other specialties.

If an aggressor attempted to invade North America with bombers or air-breathing missiles, warning would come from radar stations always on guard. Initial counterattack, directed by a unique combination of man and electronic computer, would be by fighter-interceptor aircraft of the United States and Canada.

Were enemy bombers to survive the fighter attack, Canada's supersonic missiles would be launched by Canadian officers at the Sage direction center in Trout Lake, Ontario, just outside of North Bay. Banks of electronic computer equipment would direct the Bomarcs to their targets.

The Trout Lake installation now is taking shape in a man-made cave carved from granite, at a place called Reservoir Hill.

SILO FIRING. Sequence photos show America's first solid-fuel intercontinental ballistic missile, Minuteman, blasting out of underground silo at Cape Canaveral, Florida. This U. S. Air Force missile, described as an "economical breakthrough" in terms of procurement and maintenance costs, is simple, compact, quick-firing. Minuteman missiles will be stored underground at sites hardened against nuclear attack. Boeing is weapon system integrator, responsible for Minuteman assembly, test, launch control and ground support. The Minuteman ICBM weapon system will be operational later this year, a year ahead of original schedule.

Capability has many faces at Boeing

DISTANCE CHAMP. A Boeing B-52H missile bomber set new world distance record, flying 12,519 miles from Okinawa to Spain, non-stop, without refueling. This Strategic Air Command flight demonstrated the global reach of the missile launching Boeing B-52s.

CLEAN ROOM. In super-clean room, Boeing technician inspects magnified circuit card detail. More than 4000 Boeing people are in electronics engineering and manufacturing activities.

WATER, WATER. New U. S. Army tug-fireboat uses two Boeing gas turbine engines to drive two pumps, each handling 4000 gallons of water a minute. Turbines weigh 335 pounds each, deliver 270 hp. Tough, tested Boeing turbines also power U. S. Navy minesweeping launches, landing craft, and personnel boats.

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The first 707-320B is named

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